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IS 9196 (1979): Rotary and Linear Actuators (Ac and Dc) for Aircraft [TED 14: Aircraft and Space Vehicles]



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**SPECIFICATION FOR ROTARY AND LINEAR
ACTUATORS (AC AND DC) FOR AIRCRAFT**

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SPECIFICATION FOR ROTARY AND LINEAR ACTUATORS (AC AND DC) FOR AIRCRAFT

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Indian Standard

SPECIFICATION FOR ROTARY AND LINEAR ACTUATORS (AC AND DC) FOR AIRCRAFT

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 25 June 1979, after the draft finalized by the Aircraft Electrical Equipment Sectional Committee had been approved by the Electro-technical Division Council.

0.2 In the preparation of this standard, assistance has been derived from BS 2G. 143, AC and dc rotary and linear actuators for aircraft. British Standards Institution.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2 - 1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the general requirements and test procedures for electrically operated ac and dc rotary and linear actuators for use in aircraft.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Linear Actuator — A device providing linear motion over a distance determined by limit switches mounted either in the actuator or on the actuated device, against tensile or compressive loads and consisting basically of an electric motor and reduction gearing, together with a screw jack or rack and pinion.

*Rules for rounding off numerical values (*revised*).

2.2 Rotary Actuator — A device providing rotary motion over a distance determined by limit switches mounted either in the actuator or on the actuated device, and consisting basically of an electric motor and reduction gearing.

2.3 Cycle of Operation — Travel of the actuator in one direction followed by equal travel in the opposite direction.

2.4 Stroke — Full travel of the actuator in either direction.

2.5 Load — Either the force in Newtons on a linear actuator or the torque in Newton-meters on a rotary actuator.

2.6 Rated Load — The working load of the actuator at its rated speed.

2.7 Maximum Load — The maximum working load of the actuator irrespective of speed.

2.8 Stalling Load — The maximum load at which the actuator motor will stall.

2.9 Static Load — The maximum permissible loading of the actuator as a stressed member.

NOTE — Minimum stalling load is not less than twice rated load. Maximum load is not more than one and a half times rated load. Minimum clutch slipping load is not less than 1·88 rated load.

2.10 Type Test — The tests which shall be made on each particular class of actuator.

2.11 Acceptance Tests — The tests which shall be made on batch samples.

2.12 Routine Tests — The tests which shall be made on every actuator.

3. CLASSIFICATION

3.1 The actuators shall be classified as follows:

Type A — With a performance, as declared, over a terminal voltage range 23·5 to 28·5 V dc on a nominal 28 V dc supply, but capable of operation at reduced speed at rated load down to 22 V.

Type B — Suitable for operating over a terminal voltage range of 18 to 28·5 V dc on a nominal 28 V dc supply. (This includes

conditions of battery operation, including those of heavy discharge.)

Type C — Suitable for operation on a three phase ac supply; over a terminal voltage range of 185 to 205 V, with a frequency of 400 ± 5 percent Hz.

Type D — Suitable for operation on a single phase ac supply; over a terminal voltage range of 105 to 119 V, with a frequency of 400 ± 5 percent Hz.

4. RATING

4.1 The rated speed of the actuator at the standard temperature [as per IS : 8252 (Part I) - 1976*] shall be as required by the individual specification as declared.

4.2 The rated load at the nominal voltage and rated speed, and the time rating of the actuator at this load for the declared maximum ambient temperature and minimum pressure, shall be as required by the individual specification as declared.

4.3 At rated load, nominal voltage and rated speed, and with all parts of the actuator at the declared maximum ambient temperature, it shall be possible:

- a) for actuators used on manual control to perform, at a steady speed, three full cycles of operation consecutively, and
- b) for actuators used on automatic control, to perform one full stroke followed by one hour of continuous inching cycling at the declared operating frequency, without damage or overheating, whether the load applied during each cycle puts the actuator in tension or compression.

4.4 The stalling load of the actuator at nominal voltage and at a standard ambient temperature [as per IS : 8252 (Part I) - 1976*], with the clutch, if any, inoperative, shall be not less than twice the rated load.

4.5 At maximum load and at nominal voltage at the declared maximum ambient temperature, and with all parts of the actuator at that temperature, the actuator shall be capable of performing one full stroke of operation without damage or overheating. The maximum load shall be not more than 75 percent of the stalling load. The speed shall be stipulated during these operations.

*Environmental tests for aircraft equipment : Part I General.

4.6 The maximum and minimum times taken by the actuator in making a stroke shall be declared by the manufacturer. The time shall be within this range under all conditions of load from rated load opposing to rated load assisting, with nominal voltage, and at the declared ambient temperature.

5. DESIGN AND CONSTRUCTION

5.1 The design and construction of the actuator shall conform to applicable requirements specified in IS : 8946 - 1978* and other relevant standards. The design and installation shall be such that the minimum stalling load is not less than twice the working load of the actuator at its rated speed, and that the minimum clutch-slipping load is not less than 1.88 times of its working load at rated speed. It shall also be ensured that the maximum load on the actuator is not more than one and a half times its normal working load at rated speed.

5.2 Enclosure — The actuator shall be enclosed to prevent ingress of foreign matter, and provided with drain holes, where necessary. All joints shall be sealed, where required by the individual specification, the design and construction shall meet the requirements for spray-proofness in accordance with 6.7.

5.3 Dimensions/Weight — The overall dimensions and offset weight of the actuator shall be kept to a minimum.

5.4 Arrangements/Fixing Attachments

5.4.1 Linear actuators shall preferably be designed with the motor and screw jack axes in line or with the motor offset, that is, with the motor axis to side of, and parallel with, the line of motion of the ram. The inline type of actuator is to be used under conditions of severe vibration, for example, in power plants.

5.4.1.1 To prevent undesirable couples and bending moments being applied the means of attachment shall be so arranged that the line of application of the load always coincides with the axis of the ram.

5.4.1.2 Any end attachments fitted to the actuator shall embody a joint permitting an angular movement of not less than three degrees at

*General requirements for rotating electrical machines for aircraft.

right angles to the working plane to allow for mis-alignment between the anchorage and the axis of the actuator. At the moving end, the working point, if provided, shall have a self-aligning bearing.

5.4.1.3 Unless otherwise specified, provision shall be made for adjusting the length between the centres of the actuator, without alteration of limit switch settings, to ensure correct matching of the relative parts (the recommended amount of the adjustment being ± 6.35 mm).

5.4.2 Rotary actuators shall be provided with means to take up torque reactions, preferably by flange-mounting the actuator at the driving end.

5.4.3 All parts of the actuator, for example, the break, clutch, gears, screws, etc shall be capable of being dismantled for maintenance.

5.4.4 The design of actuators, the continuous functioning of which is vital to the safety of the aircraft and for which more than one motor is provided, shall be such that in the event of one motor failing, the other shall take up the drive without operation of the contactors. Each of the motors shall be capable of continuing to drive the cord at an appropriate reduced speed when the other fails.

5.5. Gears — The design of the gear-train shall be such that backlash between gears and the effects of vibration due to tooth impact are reduced to a minimum.

5.6 Ram — The ram in a linear actuator shall generally be designed to eliminate torque reaction from the end mountings. However, when torque reaction in the structure is acceptable, the maximum reaction of the actuator shall be declared.

5.7 Limit Switches

5.7.1 Limit switches shall be of robust construction and of snap-action and should be so arranged that they are positively operated by the ram, operating shaft or the actuated device. They shall be pre-set and sealed against unauthorized adjustment. Facilities for easy access to the switches for inspection shall be provided. In case of critical applications hermetically sealed switches shall be used.

5.7.2 Limit switches associated with three phase ac actuators shall open two lines simultaneously. Limit switches for the actuators, whose function is vital to the safety of the aircraft, should preferably interrupt the supply directly.

5.7.3 The design of the switches and of their mounting shall be such that there is no possibility of the switches being set outside the mechanical limits of movement of the ram or shaft.

5.8 Limit Stops — Means shall be provided, either in the actuator or actuated device, to prevent mechanical damage or malfunctioning in the event of limit switch failure. This protection may be in the form of additional limit switches connected electrically in series with the normal ones or of built-in mechanical clear stops.

6. REQUIREMENTS

6.1 Motor — The motor shall conform to the general requirements for rotating electrical machines for aircraft as per IS : 8946 - 1978*. The actuator should also preferably be designed to incorporate a motor complying with the relevant Indian Standard.

6.2 Brake — Where a brake is fitted, it shall not engage when the motor is energized under any condition of operation of the actuator, unless specifically designed and approved for such operation.

6.3 Clutch — If an overload clutch is provided, it shall, unless otherwise specified, be set to slip at a suitable value of load between maximum load and stalling load, under any working condition of terminal voltage and ambient temperature. The clutch shall be capable of operating at the slipping load for a period of 20 seconds or such other period as may be approved, without overheating or damage. If the actuator incorporates a slipping clutch, the load at which this is set to operate shall be suitably related to the service to be performed but shall be not less than 1.25 times the maximum load for the complete unit.

6.4 Over-run and Variations of Stroke

6.4.1 The over-run from the time of switching off the motor shall be less than the displacement corresponding to one tenth of a second at no-load speed at nominal voltage.

6.4.2 The variation of stroke shall be declared for the most arduous combinations of voltage and rated load in either direction.

6.5 Jamming — When required by the individual specification, the actuator shall be capable of freeing itself and shall not become inoperative, other than temporarily, when driven to a mechanical stop in either direction with rated load assisting and at maximum test voltage (and frequency). For actuators which shall necessarily operate in an

*General requirements for rotating electrical machines for aircraft.

emergency, for example, fuel cock actuators, it is essential that the actuator shall be capable of performing its normal operation, without delay, even at the risk of becoming permanently inoperative. It shall be demonstrated that under the most adverse conditions, such actuators would not constitute a risk of fire or explosion in the aircraft.

6.6 Static Load

6.6.1 The actuator shall be capable of withstanding the declared static load or three times the rated load, whichever is greater, without permanent set or deformation.

6.6.2 If the actuator is intended for use as a stressed part of the aircraft primary structure, it shall be designed to withstand loads defined by the aircraft constructor, due allowance being made for fatigue due to load-reversals.

6.7 Environmental Conditions — The actuator shall meet the requirements of the following:

- a) Vibration,
- b) Acceleration,
- c) Explosion proofness,
- d) Resistance to the action of aircraft fluids,
- e) Fire resistance,
- f) Water-proofing [In accordance with IS : 8252 (Part VI) - 1976*],
- g) Radio interference,
- h) Compass interference,
- j) Salt,
- k) Sand dust,
- m) Fungus growth, and
- n) Humidity.

NOTE — Till such time Indian Standards on environmental tests for aircraft equipment are made available, the requirements for the above tests shall be subject to agreement between the manufacturer and the purchaser.

7. DECLARATION OF PERFORMANCE

7.1 In addition to the data in the standard form of declaration as per IS : 7855 - 1975†, the following information shall be furnished by the manufacturer in respect of the actuator:

- a) Any special voltage limitations, which may be applicable;

*Environmental tests for aircraft equipment : Part VI Water proofness.

†Form of declaration of performance of aircraft electrical equipment.

- b) Rated load at rated speed, the maximum load irrespective of its speed and the stalling load at nominal voltage;
- c) Static load and/or clutch setting and tolerance, if a clutch is provided;
- d) Normal stroke (or angle of rotation) and tolerance, and retracted length (for linear actuators);
- e) The maximum and minimum time for normal stroke (or angle of rotation) with or against rated load at nominal voltage at any ambient temperature in the range of 22 - 32°C;
- f) Ambient temperature and pressure range of operation;
- g) Time rating or ratings of the actuator; and
- h) Any special features or deviations and consequential installation limitations.

8. MARKING

8.1 Name Plate — The following data shall be marked on a name plate to be mounted on the body of the actuator in a position, where it can be easily read:

- a) Manufacturer's name,
- b) Part No. and serial No.,
- c) Nominal voltage,
- d) Rated load and speed, and
- e) Declared stroke/angle of rotation.

8.1.1 The aircraft electrical equipment may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

9. TESTS

9.1 The following shall constitute the type tests:

- a) Physical examination (9.4),
- b) Initial run (9.5),

- c) High voltage (**9.6**),
- d) Insulation resistance (**9.7**),
- e) Performance (**9.8**),
- f) Over-run and variations in stroke (**9.9**),
- g) Endurance (**9.10**),
- h) Environmental (**9.11**),
- j) Check for over-heating (**9.12**),
- k) High-temperature functioning (dry heat) (**9.13**),
- m) Static load (**9.14**),
- n) Stalling (**9.15**),
- p) Low-temperature functioning (**9.16**),
- q) High-altitude (**9.17**),
- r) Operation without limit switches (**9.18**), and
- s) Dimensional check for wear (**9.19**).

9.2 The following shall constitute the acceptance tests:

- a) Performance (**9.8**),
- b) Insulation resistance (**9.7**),
- c) Over-run and variations in stroke (**9.9**),
- d) Short endurance (**9.20**),
- e) Low-temperature functioning (**9.21**), and
- f) Dimensional check for wear (**9.22**).

9.2.1 A recommended sampling scheme is given in Appendix A.

9.3 The following shall constitute the routine tests:

- a) Physical examination (**9.4**),
- b) Short endurance (**9.20**),
- c) Performance (**9.8**),
- d) Travel (**9.23**),
- e) Clutch-setting (**9.24**),
- f) Low-temperature functioning (**9.21**), and
- g) Dimensional check for wear (**9.22**).

9.4 Physical Examination — The actuator shall be examined for conformity with **5** and **8**. The quality/workmanship shall be visually inspected. Parts liable to wear shall be dimensionally checked and verified against appropriate drawings/data. The initial dimensions and the temperature at which the measurements are made shall be recorded. The

initial resistance of the windings shall be measured and corrected to a standard temperature as per IS : 8252 (Part I) - 1976*.

9.5 Initial Run — The cold motor, with brake coil, if any, shall be coupled to a suitable load in such a manner that its output can be measured. The current consumption and armature speed shall be measured over a range of output torques from 0 to 150 percent of the torque that corresponds to the rated load of the actuator for both directions of rotation of the motor and at the maximum and minimum test voltages. The observations so made shall be checked against the values declared by the manufacturer.

9.6 High Voltage Test — With the motor still hot after having been run continuously at maximum test voltage on no load for its time rating, the insulation of the actuator shall withstand a test voltage of not less than 500 V rms, at 50 Hz for Types A and B or 1 000 V rms at 50 Hz for Types C and D applied for 5 seconds between each group of connections and the frame, with all other groups connected to the frame. The voltage shall be increased and decreased gradually. Capacitors, transistors and similar components connected to earth and liable to damage may be disconnected during these tests.

9.7 Insulation Resistance Test — With the motor still hot after having been run continuously at maximum test voltage on no load for its time rating, the insulation resistance shall be measured at a voltage of 500 V dc. The resistance between each group of terminals and frame, with all other groups connected to the frame, shall be not less than 2 M Ω for actuators whose nominal voltage is 28 V dc and not less than 5 M Ω for those whose nominal voltage is 200 or 115 V ac.

9.8 Performance Test

9.8.1 Performance tests on a complete actuator unit shall embrace all considerable aspects of loading that it might meet with in service. Increment of load from zero to maximum load shall be chosen so that a complete set characteristics may be obtained from the results of the test. The tests shall be made at both maximum and minimum test voltage and frequency in the most arduous combinations.

The following data shall be recorded during the test:

- a) Current and power input,
- b) Load — i) For linear actuator — Tensile and compressive,
 ii) For rotary actuator — Clockwise and counter-clockwise,

* Environmental tests for aircraft equipment : Part I General.

- c) Velocity — i) For linear actuator — cm per second,
ii) For rotary actuator — Degrees per second,
- d) For linear actuator — Length of stroke,
For rotary actuator — Angle of rotation of output shaft,
- e) Direction of load — Opposing and assisting the direction of motion of the actuator,
- f) Ambient temperature, and
- g) Any unusual conditions.

9.8.2 Operation at Minimum Voltage — The minimum voltage at which the actuator shall operate against rated load at a standard temperature as per IS : 8252 (Part I) - 1976* shall be determined and recorded.

9.8.3 Starting Characteristics — The starting characteristics of the actuator shall be as declared by the manufacturer.

9.9 Over-run and Variations in Stroke — The actuator shall be run under each of the following conditions for a full stroke, with maximum and minimum test voltage successively applied at the terminals; and with the motor running:

- a) counter-clockwise with no load;
- b) clockwise with no load;
- c) counter-clockwise with rated load assisting;
- d) clock wise with rated load opposing;
- e) counter-clockwise with rated load opposing; and
- f) clockwise with rated load assisting.

The maximum deviation from the nominal stroke or angle of rotation under these conditions shall be determined and shall be within the declared tolerance. The amount by which the actuator overruns the limit switches shall also be determined and in all cases shall conform to the provisions of 6.4.

9.10 Endurance Tests

9.10.1 Actuators required for general purpose shall be subjected to tests specified in 9.10.5 with the addition of 1 000 cycles of full stroke operation. Actuators required for use on non-inching manual controls only shall conform to the requirements of 9.10.6. Throughout test, the actuator shall be operated at the nominal voltage on rated load and speed.

* Environmental tests for aircraft equipment : Part I General.

9.10.2 When an auxiliary or emergency motor is incorporated in the actuator, an additional 10 percent of the test cycles prescribed shall be made using that motor.

9.10.3 When two identical motors are incorporated in the actuator, both of which normally operate in parallel, 10 percent of the test cycles prescribed shall be made with only one motor functioning.

9.10.4 When the actuator is designed to operate more than one ram unit simultaneously, it shall be tested with all such ram units loaded and in operation unless otherwise agreed.

NOTE — The total number of cycles operated shall be equally divided between loads which shall exert clockwise and counter-clockwise torques on the motor shaft. A cycle shall comprise of one operation with the load opposing plus one operation in the reverse direction with the load assisting.

9.10.5 *Automatically Controlled Actuators* — The actuator shall be operated for 200 N (where N is the inching cycles per hour) inching cycles at each end of the stroke in such a manner that both limit switches are operated 200 N times. It shall then be operated for a further 600 N cycles over any 10 percent part of its stroke. The rate of cycling shall be not less than N cycles per hour. The insulation resistance shall be measured and recorded every 200 N cycles. When the number of inching cycles per hour (N) is not specified by the purchaser, the tests shall be made on the basis of the number of cycles declared by the manufacturer, which shall not be less than 50.

9.10.6 *Manually Controlled Actuators* — Actuators associated with landing and take-off, or any services which normally function only once per flight, shall be operated for 5 000 cycles over the complete stroke. Actuators used on any other manually controlled service shall be operated for 10 000 complete cycles. The insulation resistance shall be measured and recorded every 1 000 cycles. In addition, actuators in this category shall be subjected to a modified inching test consisting of 1 000 cycles over any 10 percent of the stroke, after which no excessive wear (which adversely affects the steady smooth operation of the actuator) shall be apparent.

A sufficient rest period to allow the actuator to cool to near ambient temperature is permissible between successive cycles during both parts of endurance test.

9.10.7 On completion of all the endurance tests, the performance of the unit shall be checked as detailed in 9.8 but at minimum test voltage and on no load and rated load only. The performance figures obtained shall be within 10 percent of the corresponding values previously recorded.

The overrun/variation test in 9.9 shall then be repeated, and the unit shall again comply with all the specified requirements.

9.10.8 If, at the conclusion of the tests in 9.10.2 to 9.10.7 the insulation resistance is found to be less than that specified in 9.7 the reason for the failure to attain this value shall be investigated and a record of any corrective action necessary to achieve it be made.

9.11 Environmental Tests — The actuator shall function satisfactorily when subjected to appropriate environmental conditions specified in 6.7.

9.11.1 Vibration — The actuator shall function satisfactorily when subjected to vibration of appropriate grade (see Note below 6.7). When practicable, the actuator shall be operated at nominal voltage on no load during the resonance search test.

9.11.1.1 During the endurance tests, the actuator shall be checked every hour for satisfactory operation at minimum test voltage on no load.

NOTE — The vibration amplitudes are to be measured at the actuator fixing points and the test table balanced.

9.11.2 Acceleration Test

9.11.2.1 The actuator shall function satisfactorily when subjected to acceleration of the appropriate grade (see Note below 6.7). The actuator shall be mounted complete on an acceleration table and subjected to accelerations applied in each direction for one minute in each of three attitudes mutually at right angles. During acceleration, it shall operate satisfactorily at minimum test voltage on no load and the measured input watts shall not exceed the normal value by more than 10 percent. No damage or distortion shall occur as a result of these tests.

9.11.2.2 In addition the actuator, whilst secured to the acceleration table by its own fixing attachments, shall be subjected to an acceleration of 25 g in each of three attitudes mutually at right angles and shall withstand this acceleration without breaking away. For a linear actuator, the ram shall be fully extended during the tests.

9.11.2.3 Alternatively, this test may be made statically by suspending 25 times its own weight to the actuator in a plane through its centre of gravity. It shall not break loose under this load.

9.12 Check for Over-Heating

9.12.1 The actuator shall be run:

- a) for manual control three full strokes against rated load at nominal voltages, or for automatic control one full stroke after one hour

continuous inching at declared operating frequency, followed by a further full stroke.

- b) for one full stroke cycle against maximum load at nominal voltage.

9.12.2 At the end of each of these tests, the temperature of any part of the actuator, shall not exceed the safe limit for the particular materials used, taking the declared maximum ambient temperature into consideration.

9.13 High-Temperature Functioning (Dry Heat)

9.13.1 The actuator shall be stored in an oven at the declared maximum operating temperature until steady state conditions have been reached. It shall then operate satisfactorily at the declared minimum test voltage against rated load under the worst conditions (that is, under opposing load).

9.13.2 The actuator may be removed from the oven from this test run, but the temperature of the case shall not fall by more than 10°C, or the resistance of the windings by more than the value corresponding to a fall in temperature of 5°C, before the run is completed.

9.13.3 The whole test shall then be repeated but with the operational part carried out at nominal voltage against declared maximum load.

9.14 Static Load Tests

9.14.1 *For Linear Actuators* — The change in distance between fixing centres due to deflection and backlash shall be measured for each 10 percent increment of load, both increasing and decreasing from zero to declared static load. Tests shall be performed with the actuator both in tension and compression with the ram extended. No permanent distortion or creep shall occur.

9.14.2 *For Rotary Actuator* — The angle of displacement of the output shaft due to deflection and backlash shall be measured for each 10 percent increment of load, both increasing and decreasing from zero to declared static load. No permanent distortion or creep shall occur.

9.15 Stalling Test

9.15.1 The actuator shall be loaded with increments of load of about 10 percent from rated load until the motor fails to start or the clutch slips, with nominal voltage, applied to the terminals, and in addition the stalling load at minimum voltage shall be determined.

9.15.2 The test shall be of one full stroke cycle per increment, and shall be performed as follows:

- a) For linear actuators:
 - i) with ram in tension; and
 - ii) with ram in compression.
- b) For rotary actuators:
 - i) with anti-clockwise load torque; and
 - ii) with clockwise load torque.

9.15.3 The clutch, if incorporated, shall operate in accordance with **6.3** within limits declared by the manufacturer. If the clutch slips, it shall be rendered inoperative and the test continued, and the motor shall not stall at less than 200 percent of the rated load.

9.16 Low-Temperature Functioning Test (Type Test)

9.16.1 The actuator shall be brought to the declared minimum ambient temperature throughout. While at this temperature, the actuator shall be mounted in a horizontal position, with the ram fully extended in the linear type, in a humidity chamber controlled at not less than 95 percent humidity at any temperature between 22 and 32°C, until the hoar-frost formed on the actuator has liquefied. As soon as this has occurred, the actuator shall be returned to the cold chamber and brought again to the declared minimum ambient temperature throughout. It shall then be operated once against the rated load at minimum test voltage. For Type 'A' actuators, the minimum test voltage is 22V, for Type 'B' 18V, and for Type 'C' and 'D' 185 and 105V respectively, at 420 Hz. The time of operation under these conditions shall be declared.

9.16.2 The actuator may be removed from the refrigerator to complete the test against load, but the temperature of the frame shall not have risen more than 10°C before the test is completed.

9.16.3 The whole test shall then be repeated but with the operational part carried out at nominal voltage against declared maximum load.

9.17 High Altitude Tests — The actuator shall be placed in a vacuum chamber and subjected, at normal ambient temperature to an air-pressure equivalent to the declared maximum altitude. It shall be operated under these conditions on no load at nominal voltage for 10 percent of the duration of the appropriate endurance test at the declared frequency of operation. No damage to the limit switch contacts or to the motor brushes and commutator shall occur during this test.

9.18 Operation Without Limit Switches

9.18.1 When required by the individual specification, it shall be demonstrated that the actuator is capable of freeing itself when driven to a mechanical stop in either direction.

9.18.2 The limit switches shall be disconnected and with maximum test voltage (and frequency) applied at the terminals, and with rated load assisting, it shall be driven until the motor stalls or the clutch slips. With minimum test voltage (and maximum frequency) it should be demonstrated that the actuator is capable of freeing itself.

9.19 Dimensional Check for Wear (Type Test) — On the completion of the type-tests, the actuator tested shall be stripped and examined for signs of excessive wear or other deterioration. In addition, for actuators submitted to endurance tests, the dimensions of parts liable to wear shall be checked against those obtained during the initial check as per 9.4.

9.20 Short Endurance Test — Whilst energized at normal supply voltage, the actuator shall be operated over the complete stroke under declared load for 50 cycles, with sufficient time allowed between each cycle for it to cool to near ambient temperature. (Each cycle shall comprise of one operation with load opposing plus one operation in the reverse direction with the load assisting.) Immediately after this, and while the actuator is still hot the insulation resistance shall be measured at 500 V dc. The resistance between each group of terminals and the frame, with all other groups connected to the frame shall be not less than $2M\Omega$ for actuators whose nominal voltage is 28 V dc and not less than $5M\Omega$ for those actuators for which the nominal voltage is 200 or 115V ac.

9.21 Low-Temperature Functioning Test (Acceptance and Routine Tests) — The actuator shall be tested as per 9.16 but at rated load and nominal voltage only.

9.22 Dimensional Check for Wear (Acceptance and Routine Tests) — The actuator shall be dismantled and examined for signs of wear. If the actuator is to be re-assembled after reconditioning, it shall be submitted to the normal routine tests before reacceptance for delivery.

9.23 Travel Test — The deviation possible from the nominal stroke or angle of rotation shall be determined as detailed in and under the conditions which gave the maximum value during the type test of the actuator. The value thus determined shall be within the tolerance specified in the relevant declaration of performance.

9.24 Clutch-Setting — If a clutch or other torque-limiting device is incorporated the actuator shall be operated as detailed in **9.15**, until it slips. The load at which slipping occurs shall be between the upper and lower limits of setting load specified in the relevant declaration of performance.

APPENDIX A

(Clause 9.2.1)

RECOMMENDED SAMPLING SCHEME

A-1. SELECTION OF SAMPLES

A-1.1 Unless otherwise agreed with the approving authority, sample actuators for acceptance tests shall be selected on the following basis.

A-1.1.1 At the commencement of production, or when production recommences after a lapse of six months or more, acceptance tests shall be made on one of the first units produced from each source of manufacture.

A-1.1.2 When the quantity scheduled for production is less than 100, one unit shall be selected for testing, except that the test may be omitted at the discretion of the approving authority when the quantity does not exceed 10.

A-1.1.3 Acceptance tests shall be applied to one unit in every 100 produced, or one test shall be made in every six months, whichever provides the greater frequency of testing, for the first 300 units produced.

A-1.1.4 Subject to verification that a satisfactory standard of manufacture prevails, the frequency of testing may then be reduced to one unit in every 500, or one test in every six months, whichever provides for the greater frequency of testing.

A-1.1.5 When production exceeds 250 units per month, the frequency of testing shall be one in every two months while such production rate continues.

The samples shall be selected from current production and shall have previously passed the routine tests. During the acceptance tests the actuator shall not be serviced in any way.

The sampling sequence shall be recommenced upon the introduction of a major modification.

A-1.2 If the actuator fails during any portion of the acceptance tests, it shall be dismantled for examination and a report on the cause of failure shall be made to the approving authority. Another actuator shall be selected from the same production batch and the tests recommenced.

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IS:

- 2032 (Part XV) - 1976 Graphical symbols used in electrotechnology : Part XV
Aircraft electrical symbols
- 7854 - 1975 Voltages and frequency for aircraft electrical systems
- 7855 - 1975 Form of declaration of performance of aircraft electrical equipment
- 7856 - 1975 Safety features for ground power units for direct current aircraft servicing
and engine starting
- 7857 - 1975 Aircraft-fuel nozzle grounding plugs and sockets
- 7915 - 1976 Dimensions for connections for aircraft ground electrical supplies
- 8252 (Part XVIII) - 1978 Environmental tests for aircraft equipment : Part XVIII
Magnetic influence
- 8705 - 1978 Static invertors for aircraft
- 8706 - 1978 Safety features for alternating current ground power units for aircraft
servicing
- 8834 - 1978 Dimensions for general purpose push-pull three-pole circuit-breakers for
aircraft
- 8852 - 1978 Dimensions for general purpose push-pull single-pole circuit-breakers for
aircraft
- 8946 - 1978 General requirements for rotating electrical machinery for aircraft
- 8980 - 1978 General purpose push-pull single-pole circuit breakers for aircraft
- 8981 - 1978 Extra low voltage and low voltage spring return nonlatch switches for
aircraft